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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/734,328	12/12/2003	Mohammed Shaarawi	200309536-1	1352

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EXAMINER	
RAYMOND, BRITTANY L	

ART UNIT	PAPER NUMBER
1756	

DATE MAILED: 11/16/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/734,328	SHAARAWI ET AL.	
	Examiner	Art Unit	
	Brittany Raymond	1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-54* is/are pending in the application.

4a) Of the above claim(s) *53 and 54* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-52* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *12/12/2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *06092005/12122003*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:

   I. Claims 1-52, drawn to a method of making a void in a photoresist layer, classified in class 430, subclass 322.

   II. Claims 53-54, drawn to a fluid emitter product, classified in class 347, subclass 47.

The inventions are distinct, each from the other because of the following reasons:

Inventions I and II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make another and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case, the process as claimed can be used to make another and materially different product such as a trench in a semiconductor device.

Because these inventions are independent or distinct for the reasons given above and there would be a serious burden on the examiner if restriction is not required because the inventions have acquired a separate status in the art due to their recognized divergent subject matter, restriction for examination purposes as indicated is proper.

2. During a telephone conversation with Mr. James McDaniel on 9/16/05 a provisional election was made with traverse to prosecute the invention of Group I, claims 1-52. Affirmation of this election must be made by applicant in replying to this

Office action. Claims 53 and 54 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

3. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Specification

4. The disclosure is objected to because of the following informalities: In lines 7 and 9 of paragraph [0035] in the specification, the number "82" should be "83".

Appropriate correction is required.

Claim Objections

5. Claim 31 is objected to because of the following informalities: The phrase "an layer" in line 2 of claim 31 should be "a layer". Appropriate correction is required.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 1 and 4 are rejected under 35 U.S.C. 102(b) as being anticipated by Tzu (U.S. Patent 6093507).

As to claim 1, Tzu ('507) discloses a method for forming a phase shifting mask that includes exposing a first pattern of the layer of resist using a first exposure dose and exposing a second pattern using a second exposure dose, wherein the second exposure dose is less than the first exposure dose (Column 3, Lines 27-32 and Claim 1). The description also states that this process is followed by a developing and baking step (Column 3, Line 34).

As to claim 4, Tzu ('507) discloses that the baking occurs after the first and second exposures (Column 3, Line 34).

The recitation of "baking the layer" in claim 1 does not include when the baking is to occur.

Tzu ('507) teaches every limitation of claims 1 and 4 and thus anticipates the claims.

8. Claims 1 and 4–6 are rejected under 35 U.S.C. 102(a) as being anticipated by Cauchi (U.S. Patent Application 2003/0113674).

As to claim 1, Cauchi ('674) discloses a process for forming a resist pattern, which includes exposing the wafer through a first mask with a first dose of energy, baking the wafer, exposing the wafer through a second mask with a second dose of energy and baking again (Table 1, Paragraph 0020). Cauchi ('674) states in part (b) of claim 1, that the second dose of radiation is insufficient by itself to develop the pattern. It would be reasonable to infer that this means that the second dose of radiation is less than the first dose of radiation.

As to claim 4, Cauchi ('674) discloses that there is a baking step after the second exposure through the second mask (Table 1, Paragraph 0020).

As to claim 5, Cauchi ('674) discloses that there is a baking step after the first exposure and before the second exposure, as well as after the second exposure (Table 1, Paragraph 0020).

As to claim 6, Cauchi ('674) states that the first mask has a clear region and a non-clear region (Claim 1, Step (a)). Cauchi ('674) also discloses that the second mask has a clear region, which is at a position of at least a portion of the non-clear region of the first mask (Claim 1, Step (b)). This creates three portions on the layer, one being completely exposed, one portion being partially exposed, and the other not being exposed at all.

Thus, Cauchi ('674) teaches every limitation of claims 1 and 4-6 and thus anticipates the claims.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

10. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tzu (U.S. Patent 6093507) and/or Cauchi (U.S. Patent Application 2003/0113674) in view of Noritake (U.S. Patent Application 2002/0076845).

The teachings of Tzu ('507) and Cauchi ('674) have been discussed in paragraphs 7 and 8 above.

Tzu ('507) and Cauchi ('674) fail to disclose that a depression forms at the surface of the layer in the second portion during baking.

Noritake discloses an exposure process wherein a photosensitive resin film is exposed two times by two different masks (Paragraphs 0028–0030). Each exposure has a different dose of energy. The first exposure has a dose of 30-40 mJ/cm^2 (Paragraph 0028) and the second exposure has a dose much higher at 300-400 mJ/cm^2 (Paragraph 0031), in order for a concave to form. The film is developed after removing the second mask and the concave (74 of Fig 1d) is formed (Paragraph 0032).

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have modified the processes of Tzu ('507) and/or Cauchi ('674) by having a depression form when developing the resist, as suggested by Noritake, because Noritake teaches that a concavity is formed when two exposures at different doses are used.

11. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tzu (U.S. Patent 6093507) and/or Cauchi (U.S. Patent Application 2003/0113674) in view of Cauchi (U.S. Patent Application 2004/0101790).

The teachings of Tzu ('507) and Cauchi ('674) have been discussed in paragraphs 7 and 8 above.

Tzu ('507) and Cauchi ('674) fail to state that the baking occurs at a temperature in the range of 80-120 degrees Celsius.

Cauchi ('790) discloses a photoresist exposure process that has two exposures, each having a baking step afterwards (See Figure 2). Cauchi ('790) states that the baking takes place at between 110 and 140 degrees Celsius (Paragraph 0027), which is within the range recited in claim 3 of the present invention.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have modified the processes of Tzu ('507) and/or Cauchi ('674) by having the baking step take place at a temperature in the range of 110 to 140 degrees Celsius, as suggested by Cauchi ('790) because Cauchi ('790) teaches such temperature range leads to an improved pattern in a lithographic process using two exposures at different exposure doses.

12. Claims 11, 12, 16, 21-26, 29, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tzu (U.S. Patent 6007324) in view of Cauchi (U.S. Patent Application 2003/0113674).

Tzu ('324) discloses a method of making a resist pattern comprising the steps of exposing a first pattern in the top and bottom portions of the layer and exposing a

second pattern into the top portion of the layer with a second exposure dosage, wherein the first pattern lies within the second pattern and the first exposure dose is greater than the second exposure dose (Claim 1). Since the patterns overlap, this forms a third portion that is exposed twice. While Tzu ('324) does not teach if the photoresist is positive or negative, it is clear from the description in column 6, lines 37 to 41 and 64 to 67 and Figures 4 and 5, that the photoresist is positive. This means that this process would be the opposite of what is recited in claim 11 in the present invention. However, the developing process of Tzu ('324) forms the same pattern with a void extending through the layer in the third portion and a depression forming at the surface of the second portion, which encloses the void (See Figure 4), as stated in claim 12 of the present invention. Tzu ('324) shows that the pattern of the first mask has a non-transmissive portion, which corresponds to the first and second portions of the present invention, and a transmissive portion, which corresponds to the third portion of the present invention (Figures 3 and 4). Tzu ('324) also shows that the pattern of the second mask has a non-transmissive portion, which corresponds to the first portion of the present invention, and a transmissive portion, which corresponds to the second and third portions of the present invention (Figures 3 and 4). The first and second masks are the opposite of what is claimed in the present invention because the photoresist of Tzu ('324) is positive, whereas the photoresist of the present invention is negative. If the photoresist of Tzu ('324) were negative, then the masks would match what is claimed in claim 16 of the present invention. Also, when the masks are exposed together, they have transmissive, partially transmissive and non-transmissive portions

that expose the three different portions of the resist, as stated in claim 29 of the present invention. In the description of the invention, Tzu ('324) states that the first exposure occurs before the second exposure (Column 5, Lines 13-19), which is claimed in claim 21 of the present invention. Tzu ('324) also states that the exposure steps can be reversed, having the second exposure before the first exposure (Column 5, Line 48), as claimed in claim 22 of the present invention.

Tzu ('324) fails to describe a baking step after either of the two exposures in the process.

The teachings of Cauchi ('674) have been discussed in paragraph 8 above. These teachings describe what is being recited in claims 23 through 26 of the present invention. Cauchi ('674) also discloses that the photoresist can be negative (Claim 4), as recited in claim 30 of the present invention.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have modified the method of Tzu ('324) and added a baking step after the second exposure, as suggested by Cauchi ('674), because it is well known by one of ordinary skill in this art that baking helps to remove unwanted portions of the resist and to have the patterned portion adhere to the substrate. It would have also been obvious to have added a baking step after the first exposure as well as after the second exposure, as suggested by Cauchi ('674), because this would further help to remove unwanted portions of the resist to help adhere the patterned portion to the substrate. Finally, it would have been obvious to have used a negative photoresist in the process of Tzu ('324) instead of a positive photoresist because both types of

photoresists are commonly used in the art and would not require undue experimentation by one of ordinary skill in the art.

13. Claim 13-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tzu (U.S. Patent 6007324) in view of Cauchi (U.S. Patent Application 2003/0113674) as applied to claims 11, 12, 16, 21-26, 29, and 30 above, and further in view of Okoroanyanwu (U.S. Patent 6589713).

The teachings of Tzu ('324) and Cauchi ('674) have been discussed in paragraph 12 above.

Tzu ('324) and Cauchi ('674) fail to disclose that the void's lower portion and the depression have substantially circular cross-sections, the circumference of the void's lower portion is within the circumference of the depression, the depression has a generally parabolic shape, and the void's lower portion and the depression are substantially concentric.

Okoroanyanwu discloses a process for forming vias wherein radiation is provided through a mask to form an aperture, which can be circular in shape (Column 4, Line 35), as recited in claim 13 of the present invention. A step of etching is performed after this to form a circular hole within the aperture (Column 5, Lines 35-40), also recited in claim 13 of the present invention. When formed, the aperture can have a parabolic shape (See Figure 4), as recited in claim 14, and it is concentric with the circular hole (See Figure 15), as recited in claim 15.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have modified the method of making a resist pattern of Tzu

('324) and Cauchi ('674) by making the depression and void circular in shape, such as a parabolic shape for the depression, with the void lying with the depression, as suggested by Okoroanyanwu, because the purpose of the invention is to produce a fluid emitter and fluid is able to flow more easily through a shape with rounded edges. It would have also been obvious to have made the void and depression concentric, as suggested by Okoroanyanwu, because more fluid can be emitted at one time if the two have a common center.

14. Claims 27 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tzu (U.S. Patent 6007324) in view of Cauchi (U.S. Patent Application 2003/0113674) as applied to claims 11, 12, 16, 21-26, 29, and 30 above, and further in view of Cauchi (U.S. Patent Application 2004/0101790).

The teachings of Tzu ('324) and Cauchi ('674) have been discussed in paragraph 12 above.

Tzu ('324) and Cauchi ('674) fail to disclose that the layer is baked at 80-120 degrees Celsius and that it is baked for up to five minutes.

Cauchi ('790) discloses a photoresist exposure process that has two exposures, each having a baking step afterwards (See Figure 2). Cauchi ('790) states that the baking takes place for 90 seconds at between 110 and 140 degrees Celsius (Paragraph 0027), which are within the ranges recited in claims 27 and 28 of the present application.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have modified the process of making a resist pattern of Tzu

('324) and Cauchi ('674) by having the baking step last in the range of 90 seconds long at a temperature around 110 to 140 degrees Celsius, as suggested by Cauchi ('790) because Cauchi ('790) teaches such temperature and time ranges lead to an improved pattern in a lithographic process using two exposures at different exposure doses.

15. Claims 31-36, 41-48, and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tzu (U.S. Patent 6007324) in view of Cauchi (U.S. Patent Application 2003/0113674), Okoroanyanwu (U.S. Patent 6589713), and/or Cauchi (U.S. Patent Application 2004/0101790) as applied to claims 11-15, and 21-30 above, and further in view of Makigaki (U.S. Patent 6863375).

The teachings of Tzu ('324), Cauchi ('674), Okoroanyanwu, and Cauchi ('790) have been discussed in paragraphs 12-14 above.

Tzu ('324), Cauchi ('674), Okoroanyanwu, and Cauchi ('790) fail to disclose forming a nozzle and counter bore in the photoresist layer.

Makigaki discloses a silicon nozzle plate that has nozzles each with a first nozzle portion and a second nozzle portion that both have circular cross-sections. The circular cross-section of the first nozzle is smaller than the circular cross-section of the second nozzle portion (Claim 1). The first and second nozzle portions are formed by patterning a resist film, formed on a substrate (Claim 2). Makigaki also discloses that an ink supply hole, which is assumed to be similar to a counter bore, can be formed at the bottom of the nozzle (Column 6, Line 33).

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have modified the method of forming a pattern in a photoresist

of Tzu, Cauchi ('674), Okoroanyanwu, and Cauchi ('790) by further forming a nozzle and counter bore in the layer, as suggested by Makigaki, because Makigaki teaches that it is known to make a fluid emitting nozzle photolithographically using photoresist films.

16. Claims 7-10, 17-20, 37-40, and 49-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tzu (U.S. Patent 6093507), Cauchi (U.S. Patent Application 2003/0113674), Tzu (U.S. Patent 6007324), Okoroanyanwu (U.S. Patent 6589713), and/or Cauchi (U.S. Patent Application 2004/0101790) as applied to claims, 1, 6, 11, 16, 31, and 36.

The teachings of Tzu, Cauchi ('674), Tzu ('324), Okoroanyanwu, and Cauchi ('790) have been taught in paragraphs 7, 8, 12, and 15 above.

Tzu ('507), Cauchi ('674), Tzu ('324), Okoroanyanwu, and Cauchi ('790) fail to teach the range of doses recited in claims 7-10, 17-20, and 37-40. They also fail to teach the range of sizes recited in claims 49-51..

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have used the range of doses and range of sizes recited in the claims being rejected because the range of exposure doses depends on the photoresist being used and can be determined by one of ordinary skill in the art without undue experimentation to form the desired nozzle with the desired dimensions.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brittany Raymond whose telephone number is 571-272-

6545. The examiner can normally be reached on Monday through Friday, 8:00 a.m. - 4:30 p.m. EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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